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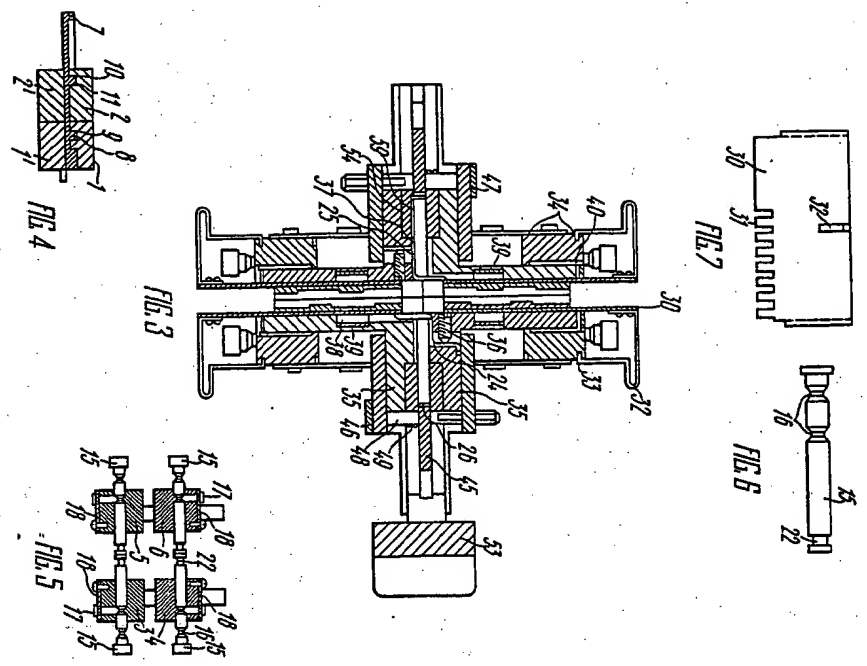
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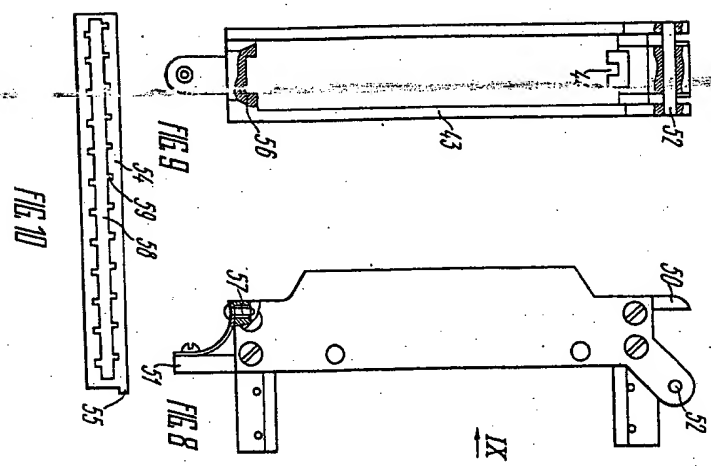
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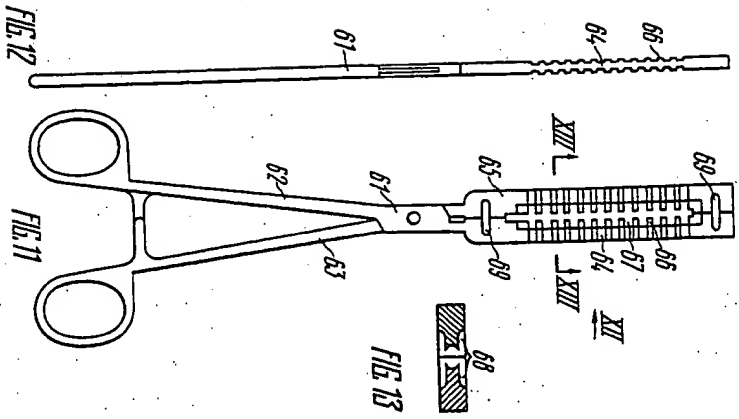
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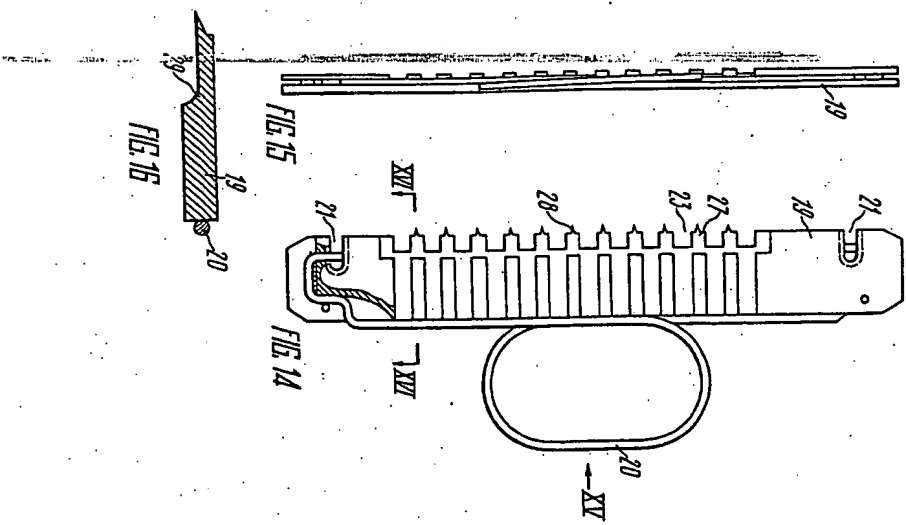
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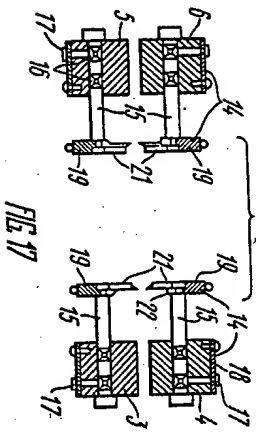


FIG. 17

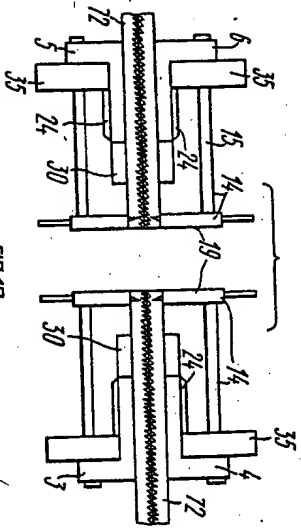


FIG. 18a

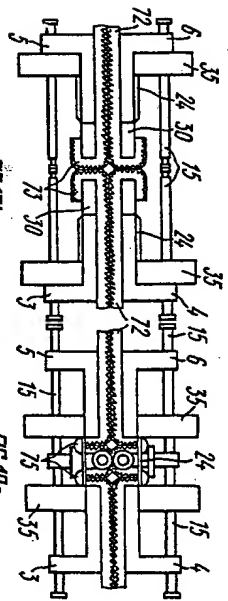


FIG. 18b

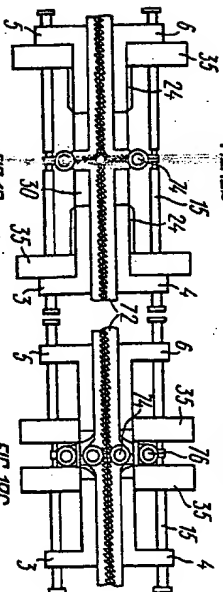


FIG. 18c

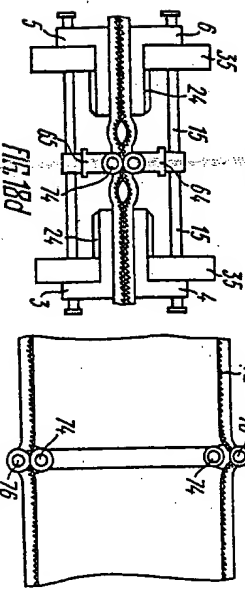


FIG. 18d

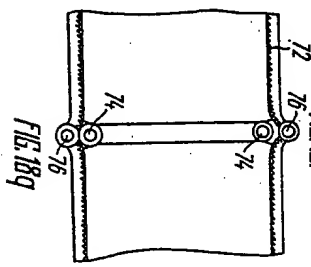


FIG. 18e

SPECIFICATION

Device for applying anastomoses onto hollow organs

The present invention relates to medical instrumentation, and more particularly it relates to surgical suturing devices, such as devices for applying anastomoses onto hollow organs, e.g. the organs of the digestive tract, for instance, for joining intestines in the end-to-end, end-to-side or side-to-side manner, without introducing the working parts of the device into the lumen of the organs being sutured.

The present invention has for its aim to provide a construction of the suturing part of the device, which should enable to select the optimized-length portions of the organ, to be sutured without tending the device off the organ, and to suture the walls exclusively through the serous-muscular layer, when applying single- or double-level sutures.

This aim is attained in a device for applying anastomoses into hollow organs, comprising two substantially similar parts provided with means for their coupling at suturing, each one of these parts including two physically connected handles, each handle carrying at the free end thereof a flat plate, the pair of these plates defining a flat clamp;

removable magazines with grooves, pushers and dies for bending the staples or apertures, mounted on the outer surfaces of the flat plates, in which devices, in accordance with the invention, each clamp is provided with means for shifting layers of the intestine edge to edge, as a suture or cauterization is formed, the means including a plate having a comb so arranged that the longitudinal axis thereof passes along the connection plane of the coupled parts and adapted to travel only perpendicularly to the longitudinal axis of the connection plane, sharp points provided on the projections of the comb-like plate, whose height is somewhat less than the thickness of the intestine wall, a slot arranged on the inner side of the comb-like portion facing the intestine and engaging each projection of the comb and partially the plane of the comb proper, an adjustable support carrying the comb-like plate and the flat plate forming the clamp, enabling members of the adjustable support adapted to its travel in a required position after its travel parallel to the axis of the flat clamps, whereas used as a die is a needle-like die, which die is movably mounted in the plane of flat plates forming the clamp.

It is expedient that each clamp should be provided with a removable plate with grooves, movably mounted intermediate the plane of the needle-like dies and the outer surface of the flat plates of the clamp, for displacement relative to the edges of this plate.

It is further expedient that the adjustable supports adapted to travel in the plane of the axis of the flat clamps be in the form of rods with grooves engageable by the spring-biased retaining means.

According to one embodiment of the invention, the flat plate defining the clamp has enlarged portions with grooves serving as guides for the displacement of the die and of the plate with the grooves.

Owing to the disclosed structure of the suturing part of the device, the precise optimized-length portions of the organ would be always selected for forming the first and second level of the sutures, irrespectively of the personal experience of the surgeon, thus positively ensuring the minimized reduction of the lumen of the anastomosis; the suturing would be conducted without compressing excessively the tissue of the organ along the line of the suture; it is possible to apply double-level buried sutures without shifting the device; when buried sutures are made, it is ensured that the tissue is sutured exclusively through the serous-muscular layer.

The invention will be further described in connection with embodiments thereof, with reference being made to the accompanying drawings, wherein:

FIG. 1 is a general view in plan of a device embodying the invention;

FIG. 2 is a view taken along arrow IX in FIG. 1, in accordance with the invention;

FIG. 3 is a sectional view taken on line III-III of FIG. 1;

FIG. 4 is a sectional view taken on line IV-IV of FIG. 1;

FIG. 5 is a sectional view taken on line V-V of FIG. 1;

FIG. 6 shows the support in the form of a grooved rod;

FIG. 7 shows the movable plate;

FIG. 8 shows the housing adapted to accommodate the staple magazine (I.a), the magazine holder;

FIG. 9 is a view taken along arrow IX in FIG. 8;

FIG. 10 shows the staple magazine;

FIG. 11 shows the clamp for applying double-level buried sutures;

FIG. 12 is a view taken along arrow XII in FIG. 11;

FIG. 13 is a sectional view taken on line XIII-XIII in FIG. 11;

FIG. 14 shows the removable movable plate with the grooves;

FIG. 15 is a view taken along arrow XV in FIG. 14;

FIG. 16 is a sectional view taken on line XVI-XVI in FIG. 14;

FIG. 17 is a sectional view taken on line XVII-XVII in FIG. 1;

FIG. 18 illustrates the routine of applying a double-level buried suture;

FIG. 18a — same as FIG. 18, with the clamps applied to the ends of the intestines to be sutured;

FIG. 18b — same as FIG. 18, with the ends of the intestines to be sutured prepared on the extended removable grooved plates;

FIG. 18c — same as FIG. 18, with the first suture level made; the grooved plates are placed inward, and the needle-like dies are spaced;

FIG. 18d — same as FIG. 18, with the clamp applied to the first suture level, to supply a double-level buried suture;

FIG. 18e — same as FIG. 18, with the handles moved closer together to form cushions of the walls

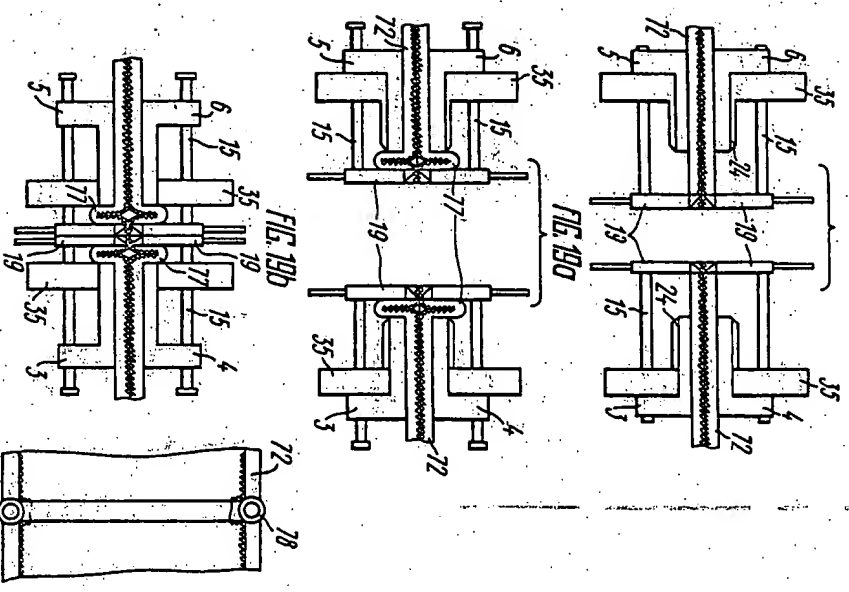


FIG. 190

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FIG. 205

FIG. 206

FIG. 207

FIG. 208a

FIG. 208b

FIG. 208c

FIG. 208d

FIG. 208e

FIG. 209

of the incisions being sutured, and the cushions are placed by the needle-like dies;

FIG. 18b—same as FIG. 18, with the second suture layer applied;

FIG. 18c illustrates the cross-section of the double-level buried suture;

FIG. 19 illustrates the routine of applying a single-level buried suture;

FIG. 18a—same as FIG. 18, with the handles 10 inserted to be sutured;

FIG. 18b—same as FIG. 18, with comb-like plates having been moved to form cushions of the walls of the incisions to be sutured;

FIG. 18c—same as FIG. 18, with the handles 15 coupled and the cushions impaled onto the needle-like dies;

FIG. 18d illustrates the cross-section of a single-level buried suture.

20 Referring now to the appended drawings, the device for suturing organs comprises two pairs of handles 1, 1' and 2, 2' (Fig. 1, 2 and 4) each handle carrying at its free end thereof flat plates 3, 4 and 5, respectively (FIG. 5). The handles of each pair are pivotally connected, as is shown, for instance, by symbols A and A', so that the flat plates 3, 4 and 5 forming a clamp are arranged in pairs in opposition to one another. The pairs of the pivotally connected handles 1, 1' and 2, 2' are interconnected by a wedge 30 (Fig. 4) is received in a slot 9 of the handle 1, while the tapered projection 10 is received in a slot 11 of the handle 2 (FIG. 4). In this way drawing together of the handles 1 and 1' in a manual fashion is provided for. To move the wedge 7 and to fix it in place, there is provided a projection 12 with a latch 13 to fit the wedge 7 in the adjusted position. Each clamp is provided with means 14 for shifting layers of the intestine edge axially as a torus or cushion is formed, adapted to preset the length of the portions included for forming the suture. Each means 14 includes four rods 15 (FIG. 5, 6) arranged on the ends of the flat plates 3, 4, 5, 6 which are essentially adjustable supports adapted to travel only perpendicularly to the axis of the flat plates 3, 4 and 5. The rods 15 are provided with indentations 16 (FIG. 6) engaging rotating members 17 which are urged by springs 18. Each means 14 incorporates two comb-like plates 19 (FIG. 14, 17) so arranged that the longitudinal axis thereof pass along the connection plane and adapted to travel only perpendicularly to the longitudinal axis of the connection plane. The comb-like plates 19 are provided with springs 20. The comb-like plates 19 are connected with aid of 55 shaped slots 21 with indentations 22 of the rods 15. The comb-like plates 19 (FIGS 14, 15, 16) have uniformly spaced through-going grooves 23 for the passage therethrough of needle-like dies 24 having on the inner side thereof grooves 25 for bending the staple 26. The slots 23 are made open in the direction of the needle-like dies 24 (FIG. 7) whereas projections 27 have sharp points 28 adapted to retain the end of the organ being sutured. On the inner side of the comb-like portion of the plates 19 facing the intestine provision is made for a slot 29 adapted to

limit the height of the cushions formed of the walls of the organs. The slot 29 engages each of the comb projection 27 and partially the plate 19 proper. Each flat plate 3, 4, 5, 6 has removable plates 30 (FIG. 7) movably mounted intermediate the plates and needle-like dies 24, each plate 30 having extending projections 31 and a spring 32 of which the end 33 (FIG. 3) is retained in slots 34 of the flat plates 3, 4, 5, 6 of the handles 1 and 2. The spacing of the flanking indentations 16 in the rods 15 and of the slots 34 in the plates 3, 4, 5, 6 equals the extent of the displacement of the rods 15 and the removable plates 30 in operation of the device, as it will be disclosed in a more detailed way hereinafter. The needle-like dies 24 (FIG. 3) are assembled into comb 35 and are mounted on each respectively plate 3, 4, 5, 6 for displacement perpendicularly to the axis of the device. The needle-like dies 24 are attached to the respective combs 35 with aid of screws 36. The grooves 25 of the needle-like dies 24 are arranged to align with the slots or grooves 37 of the comb 35. The slot 38 of the comb 35 receives a spring 39 for bending the comb 35 as the latter moves along the respective plate 3, 4, 5, 6 of the handles. The plates 3, 4, 5 and 6 of the handles 1 and 2 carry limiting screws 40. The comb 35 has projections 41 and a pin 42 for connection with a magazine holder 43. The slots 44 of the magazine holder 43 (FIGS 8, 9) accommodate a pusher 45 (FIGS 2 and 3). The magazine holder 43 has mounted thereon a safety device 46 including a plate 47, two pins 48 and two abutment screws 49. The magazine holder 43 has projections 50 for connection with the pins 42 of the combs 35, a projection 51 for facilitating detachment of the magazine holder 43 from the combs 35, and a pin 52 for connection with an arm 53. The magazine holder 43 accommodates a magazine 54 (FIGS 3, 10) of which the projection 55 is received in the slot 56 of the magazine holder 43. The magazine holder 43 further carries a spring-urged pin 57. The magazine 54 has a slot 58 for the travel of the pusher 45, and grooves 59 adapted to accommodate the legs of the staples 26, aligned with the slots 37 and grooves 25. The handle 2 has mounted thereon a pin 60. Each magazine holder 43 is connected with two combs 35 of two handles 1 and 2.

The complete set of the device includes a clamp 61 for applying double-level buried sutures. The clamp 61 is made up of two halves 62 and 63 with their 115 respective jaws 64, 65. Each jaw 64, 65 of the clamp 61 has uniformly spaced projections 66 and slots 67 which are through-going and open toward the needle-like dies 24. Longitudinal grooves 68 are cut in the projections 66 longitudinally of the jaws 64, 65 at both ends.

The clamp 61 has shaped slots 69 in the jaws 64, 65 for attachment of the clamp 61 to the indentations 22 of the rods 15. One end of each jaw 3, 4, 5 and 6 of the device has mounted thereon clamp 70, while the other end carries rotatable clip 71.

The device is operated, as follows.

A. Application of double-level buried sutures Prior to the commencing of the operation, the handles 1, 2, the magazine holders 43 with loaded 130 magazines 54 therein and the arm 53 are detached

from one another. The combs 35 of the needle-like dies 24 are spread. The rotating projections 31 of the removable plate 30 project from the plates 3, 4, 5 and 6. The handles 1 and 2 are spread.

The wedge 7 is in its initial position. The comb-like plates 19 are connected with the rods 15 which are extended from the plates 3, 4, 5 and 6 by the maximum extent (FIG. 17).

The plates 3, 4, 5 and 6 of the handles 1 and 2 are then applied onto the ends of the organs 72 to be sutured and locked with it a spring lock 70 and rotatable clip 71. The ends of the organs are trimmed along the outer side of the comb-like plates 19 (FIG. 18a), whereas the comb-like plates 19 are removed. The ends of the organs 72 are pulled over the projections 31 of the removable plates 30, to form cuff-like elements 73; the handles 1 and 2 are joined and brought together until the walls of the organ to be sutured meet (FIG. 18b). The combs 35 of the needle-like dies 24 are brought together, and the magazine holders 43 with the loaded magazines 54 therein are connected to the combs 35. The safety device 46 are pulled away, and the arm 53 is operated to press the pushers 45, in which way suturing at both sides is performed. Then the magazine holders 43 are removed, and the combs 35 of the needle-like dies 24 are spread. The first level of the sutures 74 has been thus applied (FIG. 18c).

30 The removable plates 30 are retracted into the plates 3, 4, 5 and 6, and the clamp 61 is applied onto the sutures, for its jaws 64, 65 to hold the first level of the sutures (FIG. 18d). The handles 1 and 2 are brought closer together to form cushions 75. The combs 35 of the needle-like dies 24 are projected to get them closer together, whereby the needle-like dies 24 place the cushions 75 (FIG. 18e). The clamp 61 is removed, and the combs 35 of the needle-like dies 24 are brought together. The magazine holders 43 with the loaded magazines 54 therein are connected with the combs 35 of the needle-like dies 24. The safety device 46 are pulled away, and the arm 53 is operated to press the pushers 45, in which way suturing is done at both sides. The magazine holder 76 has been thus applied (FIG. 18f). The combs 35 of the needle-like dies are spread apart, the handles 1 and 2 are opened, and the device is removed from the now sutured organ. FIG. 18g of the appended drawings illustrates the cross-section of the thus obtained double-level buried suture 76.

B. Application of a single-level buried suture Prior to commencing the operation, the device is prepared in the way similar to the preparation to the application of a double-level buried suture, except that the removable plates 30 are retracted into the plates 3, 4, 5, 6.

Prior to commencing the operation the handles 1, 2, the magazine holders 43 with the loaded magazines 54 therein and the arm 53 are detached from one another. The combs 35 of the needle-like dies 24 are spread apart as far as they will go. The jaws of the handles 1 and 2 are open.

The wedge 7 is in its initial position. The comb-like plates 19 are connected with the rods 15 which are

extended from the respective plates 3, 4, 5, 6 by the maximum extent (FIG. 17).

The plates 3, 4 and 5, 6 of the handles 1 and 2 are applied to the ends of the organ to be sutured, with the comb-like plates 19 mounted thereon. The ends of the comb-like plates 19, if bleeding from the larger vessels of the walls of the organ occurs, the vessels have ligatures applied thereon (FIG. 18a).

75 The comb-like plates 19 are moved toward the plates 3, 4, 5, 6 of the handles 1 and 2, whereby cushions 77 are formed (FIG. 18b). The handles 1 and 2 are coupled, and the combs 35 of the needle-like dies 24 are moved toward one another, whereby the needle-like dies 24 place the cushions (FIG. 18c).

80 The comb-like plates 19 are removed. The combs 35 of the needle-like dies 24 are brought together, and the magazine holders 43 are connected thereto; the arm 53 is operated to actuate the pushers 45, in which way suturing at both sides is performed. Then the magazine holders 43 are removed. There has been thus applied a single-level buried suture 78 of which the cross-section is illustrated in FIG. 18d.

80 The advantages of the proposed device over the prior art are, as follows:

1. Owing to the positive selection of the length of the portions of the organ for the formation of the first and second levels of sutures, the device ensures the minimized reduction of the lumen of the anastomosis, which reduction is always the same.
2. The device performs suturing without pressing the tissues between the walls of the sutures.
3. The device performs application of a double-level buried suture without the necessity of shifting the handles or clamps.
4. When used for making buried sutures, the device ensures that the tissue is placed exclusively through the serous-muscular layers.

CLAIMS

1. A device for applying anastomoses onto hollow organs, comprising two substantially similar parts provided with means for their coupling at suturing, each one of said parts including two pivotally connected handles, each handle carrying at its free end thereof a flat plate, removable magazine with grooves, a pusher member and dies for bending the staples or sutures mounted on the respective outer surface of the flat plate, each of said clamps having means for shifting layers of the intestine edge axially as a torus or cushion is formed, the means including a comb-like plate which is so arranged that the longitudinal axis thereof passes along the connection plane of the coupled parts for displacement only perpendicularly to the longitudinal axis of the connection plane of the parts, sharp points provided on the projections of the comb-like plates whose height is somewhat less than the thickness of the intestine wall, a slot arranged on the inner side of the comb-like portion which biases the intestine when anastomoses is applied and engaging each projection and partially the plane of the comb proper, an adjustable support carrying the comb-like portion for travel in the plane parallel to the axis of the flat clamps and intercon-

- needling the complex plate with the flat plate of the clamp, retaining members of the adjustable support adapted to fix it in a required position depending on the position of the comb-like plate after the travel thereof parallel to the side of the flat clamp.
5. Wires used as each die is a needle-like die, which die is mounted with the provision to travel in the plane of flat plates defining the flat clamp.
10. A device according to claim 1 wherein each clamp is provided with a removable plates with grooves, movably mounted intermediate the plane of the needle-like dies and the outer surface of the flat plate of the clamp, for displacement relative to the edges of this plate.
15. 3. A device of claim 1, wherein the adjustable supports adapted to travel in the plane of the side of the flat clamps are made as rods with grooves engageable by spring-urged retaining means.
20. 4. A device of claim 1, wherein the flat plates defining the clamp has enlarged portions with grooves acting as the guideways for the motion of the dies and the grooves plate.
25. 5. A device for applying anastomosis onto hollow organs, substantially as hereinbefore described and illustrated in the appended drawings.

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